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Perceived and objective neighborhood environment attributes and health related quality of life among the elderly in Bogotá, Colombia

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ABSTRACT

This study examines associations between neighborhood environment attributes and health related quality of life (HRQOL) and self-rated health (SRH) among older adults (60 years and over) in Bogotá, Colombia. Perceived and objective neighborhood environmental characteristics were assessed in a cross sectional multilevel design with 1966 older adults within 50 neighborhoods. Outcome variables included HRQOL (physical and mental dimensions) and SRH measured with the Spanish version of the Short Form 8 (SF-8). Independent variables included perceived and objective neighborhood characteristics as well as self-reported levels of walking. Hierarchical linear and logistic regression models were used for the analysis. Among perceived neighborhood characteristics, safety from traffic was positively associated with both HRQOL dimensions and SRH. Having safe parks was positively associated with the mental dimension of HRQOL and with SRH. Street noise was negatively associated with both HRQOL dimensions. Regarding objective neighborhood characteristics, residing in areas with more than eight percent of land covered by public parks was positively associated with SRH. Objective and perceived neighborhood characteristics could provide insight into potential interventions among older adults from rapidly urbanizing settings in Latin America.

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Introduction

The world population is aging at a rapid pace. In 2006, nearly 500 million people worldwide were 65 years and older (Lunenfeld, 2008). The fastest growth in older adult populations is occurring in low and middle income regions such as Latin America, where between the years 2006 and 2030, the number of older adults is projected to rise by 140%, as compared to 51% in developed countries (Gavazzi, Herrmann, & Krause, 2004). Along with these trends, non-communicable diseases have become a public health challenge as they are now the leading cause of death among the older adult population worldwide (Lopez, Mathers, Ezzati, Jamison, & Murray, 2006). In Colombia, the reduction in fertility rates and the increase in life expectancy will lead to a reduction in the population 15 years and younger and an increase in the population 60 years and older, which is projected to grow from 9.6% in 2005 to 35.8% in 2020 (Lunenfeld, 2008). This demographic transition suggests the need to adjust policies and programs to facilitate healthy aging. In this sense, research that provides evidence of the individual and social determinants of health among the older adult population is warranted.

During the past decade, there has been increased interest in determining the relationship between objective and perceived environmental attributes and several behaviors and health outcomes such as physical activity (Dawson, Hillsdon, Boller, & Foster, 2007; Li, Fisher, Brownson, & Bosworth, 2005; Nagel, Carlson, Bosworth, & Michael, 2008), obesity (Michael & Yen, 2009), disablement process (Clarke, Ailshire, Bader, Morenoff, & House,

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2008; Clarke & George, 2005), longevity (Takano, Nakamura, & Watanabe, 2002), SRH and quality of life (Wen, Hawkley, & Cacioppo, 2006), among the older adult population. Most of this evidence has been collected in high-income countries and little is known about the relationship between the built environment and quality of life among older adult populations from Latin America. To date, the only published study to explore the links between the built environment and quality of life in the region was conducted in Bogotá in 2005, among adults aged 18–65 years. The study explored particular associations between the neighborhood built environment and physical activity levels and HRQOL among the adult population of Bogotá (Cervero, Sarmiento, Jacoby, Gomez, & Neiman, 2009; Sarmiento et al., 2007). Despite this preliminary evidence, it is necessary to assess if such relationships are maintained or how they are different among the older population of Bogotá, as this population group may be more susceptible to changes in the urban environment.

Evidence supporting the association between both objective and perceived environmental characteristics and HRQOL among the older adult population is limited; however, there are plausible mechanisms for this association (O'Campo & O'Brien Caughy, 2006). Specifically, previous studies have associated access to public parks with promotion of wellbeing, social interaction and active recreation which can in turn influence quality of life (Kaczynski, Potwarka, & Saelens, 2008; Sallis et al., 2006). In addition, a study conducted by Takano (2002) found that more walkable green space had a positive influence on older adults' longevity, after controlling for individual risk factors. Likewise, perceived environmental characteristics, including noise and safety, could also influence HRQOL. In particular, noise pollution could affect quality of life, through the interference with sleep and other vital tasks. Vehicular congestion has also been recognized as an important deterrent of quality of life because of its association with noise and high prevalence of traffic accidents (Balfour & Kaplan, 2002; Fried & Barron, 2005). Unsafe environments, including those with high prevalence of crime, could be associated with high levels of environmental, physical and mental stress that can affect quality of life and mental health (Balfour & Kaplan, 2002; Bazargan, 1994; Fried & Barron, 2005).

The context of Bogotá

Bogotá is the capital and largest urban settlement of Colombia, with a population of over seven million inhabitants (DANE, 2005). In addition, Bogotá is a very densely populated city with approximately 3912 inhabitants per square kilometer (Cetina, 2008). According to the last Colombian population census conducted in 2005, 9.6% of the population of Bogotá, is 60 years and older. It is projected that between 2005 and 2020 life expectancy in Bogotá will increase from 77.1 to 78.9 years (Kinsella, 1995). Contrary to what has happened in higher income countries; the urban development of the majority of Latin-American cities such as Bogotá has been characterized by its informality and a lack of urban planning. The process of population growth has been so rapid that there has not been sufficient time to plan and build appropriate urban infrastructure (Camargo, 2005; Cerrutti & Bertoncello, 2003).

During recent decades, Bogotá has engaged in important urban and social transformations, such as the implementation of new motorized and non-motorized transportation systems, investments in recreational facilities and public parks, and recovering of public space. These transformations might influence physical activity (Parra et al., 2007), and potentially health related quality of life (HRQOL) of older adults. Despite advances of the rapid bus transit system (Transmilenio), the public transportation system continues to have important deficiencies. Additionally, the city has a shortage of 43 million square meters of public space, with just over 4 square meters of green space per inhabitant (Cetina, 2008), falling well below the international standards of public space recommended for quality of life by the United Nations Habitat of 10 square meters per inhabitant (Gebre-Egziabher, 2004).

The aim of this study was to examine the associations between some objective and perceived environmental attributes on physical and mental HRQOL in a rapidly urbanized city in Latin America, such as Bogotá.

Methods

Study design

This study was conducted in 2007 and used a cross sectional multilevel design with 1966 older adults nested in 50 residential areas. For this study, neighborhood was defined as a small geographic area (mean area 102,377 m^2, median area 80,277 m^2, SD 98,751, mean population 4211) of similar social economic status (SES) at the household level, similar physical and urban attributes, and delimited by urban or natural barriers. An architect expert in urban design identified the neighborhoods using Geographic Information Systems (GIS) and aerial-photography restitution.

A sampling frame of 1734 neighborhoods was obtained and later stratified by SES. In Bogotá, SES is determined according to the Planning Department of Bogotá which takes into account living conditions including the construction type and materials of residences occupying a sector (DANE, 2005). Based on this information, 6 categories are defined with category 1 being the most disadvantaged and category 6 being the most advantaged (DANE, 2005). The sampling frame of neighborhoods was divided in 3 strata: low, middle-low and middle-high SES neighborhoods. Low SES was comprised from strata 1 and 2, middle-low SES was comprised from strata 3, and middle-upper SES was comprised from strata 4 and 5. Neighborhoods from the highest strata (strata 6) were not included in the sampling since they only represent 1.2% of the urban population of Bogotá and the response rates among this population group are extremely low.

Sample size was based on estimates of effect sizes and required precision of the effect estimates, as well as costs and logistic limitations (IPEN). As a result, fifty-eight neighborhoods were selected using a systematic selection technique with oversampling of low and middle-low SES categories in order to increase the variability of urban forms. Eight neighborhoods were not included in the final sample due to small cell counts (less than 4). The final response rate of randomly selected older adults in the 50 neighborhoods was 67.8% (on average 39 older adults per neighborhood were surveyed, range 9–136) for a total of 1966 older adults. Only participants 60 years and older with at least one year of residence in the address were interviewed. Due to missing values in some of the dependent and independent variables, the current analysis was restricted to 1863 observations.

Study measures

A questionnaire was administered through face-to-face (in-home) interviews by interviewers with experience conducting population surveys. Interviewers received a standardized five-day training prior to data collection. The average interview time was 12 min and all the selected participants were asked to provide informed oral consent prior to the interview. Institutional Review Board approval at Fundacion FES Social was obtained prior to data collection.

Outcome variables

Health related Quality of Life (HRQOL) was assessed using the validated Spanish version of the Short Form-8 (SF-8). The license for the use of the SF-8 instrument was acquired through QualityMetric and scoring was obtained following the instrument's instructions manual (QualityMetrics, 2008). The SF-8 is an 8-item questionnaire that measures each of the eight domains of health included in the SF-36. The SF-8 produces two separate scores of HRQOL, one for physical health and one for mental health. In this study the Cronbach's alpha for this instrument was 0.86. Results from the SF-8 were treated as a continuous variable. SF-8 scales and summary measures are scored using norm-based scoring methods. The range for HRQOL scores for the physical health dimension ranges from 19.5 to 58.6 and from 17.9 to 59.3 for the mental health dimension.

Self-rated health information was obtained using the first question from the SF-8 scale that asks "Overall, how would you rate your health during the past 4 weeks?" Response options were treated as a dichotomous variable categorized as "very poor," "poor," and "fair" versus "good," "very good," and "excellent." Self-rated health has been extensively used as a separate outcome variable due to the high correlation with several health behaviors, disability, and use of health care services (Gómez et al., 2005; Kepka, Ayala, & Cherrington, 2007; Miller & Wolinsky, 2007).

Independent variables

Walking levels were determined based on adapted questions from the short version of the International Physical Activity Questionnaire ("International Physical Activity Questionnaire," 2002). Questions were culturally adapted through the use of two focus groups and eight cognitive interviews, among a selected sample of ten women and eleven men between 57 and 88 years old from various socioeconomic strata (Forsyth & Lessler, 1991; Jobe & Mingay, 1989, 1990). The questions used were 1) usually how many days of the week do you walk outside from your home in bouts that lasted at least 10 min? 2) How much time do you usually walk in any of those days? Responses were categorized in three levels $\leq$ 29 min, 30–149 min and $\geq$150 min.

Perceived environmental characteristics questions were selected to assess perceptions of the neighborhood environment. The questions were based on previous research in Bogotá and on results from focus groups and cognitive interviews conducted prior to the development of the questionnaire. The questions related to perceived environmental characteristics were: 1) safety of parks, green areas and public recreational places, 2) safety from traffic when crossing the streets; response options for these questions were categorized as "very unsafe", "unsafe" and "neither" versus "safe" and "very safe"; and 3) how much does street noise level of the place where you reside prevents you from walking? Response options were categorized as "not at all", "a little," and "moderately" versus "very much" and "extremely."

Objective neighborhood environmental characteristics variables were selected for this analysis based on the particular characteristics of the city, previous research in Bogotá (Cervero et al., 2009; Sarmiento et al., 2007), and the goal of this study. Neighborhood characteristics included: public park density, number of TransMilenio stations in each neighborhood, and the presence of a *Ciclovía*. Bogotá has one of the oldest *"Ciclovías,"* a recreational strategy that functions during weekends and holidays, in which streets are closed to motorized traffic, allowing pedestrians to engage in various forms of physical activity such as walking, biking and running. TransMilenio is a rapid mass bus transit system opened in 2000, which operates in separate traffic lanes and stations about 500 m apart. These indicators were obtained through GIS databases from the Cadastre Department and the Sports and Recreation Institute of Bogotá.

Built environment variables were measured in a crow-fly buffer of 500 m around the centroid of each neighborhood. The 500 m buffer was selected based on the urban characteristics of Bogotá (i.e., high density) and the results from qualitative information collected with a sample of older adults prior to the design of the study, which inquired about the amount of time or distance in blocks that they will be willing to walk in the neighborhood for leisure or transportation purposes. In addition, buffers of 500 m had very little spatial overlapping in the selected neighborhoods. The presence of a Ciclovía was categorized as yes versus no. Public park density was calculated dividing the total area of public parks by the total area of the buffer (500 m). Small parks, also known as pocket parks areas were not included as part of this indicator because they have less than 1000 m^2. Public park density was classified in three categories according to the tertiles distribution across all 50 neighborhoods and presented as percentage of land covered by public park areas 1) 0.01%–4.14% m^2 of green area, 2) 4.53%–7.98% m^2 of green area, and 3) 8.11%–35.21% m^2 of green area). TransMilenio stations were coded as zero versus one or more.

Individual sociodemographic characteristics were also included in the statistical analysis as control variables: age categorized into two groups (60–74 years and 75–98 years), gender, education which originally had six options (none, incomplete primary education, complete primary education, incomplete secondary education, complete secondary and more than secondary education) was collapsed as a binary variable due to its distribution, reflecting the low educational attainment of the population (66% had completed primary education and 34% reported having more than primary education). Neighborhood SES (low, middle-low and middle- upper) and time of residence in the neighborhood categorized according to tertiles of the sample distribution (1–15 years, 16–30 years, and 31–90 years). The following two questions were used as proxies of social support: living alone versus living with a partner or family members, and walking from your house, how far do the members of your family live? ("very far", "far" and "neither" versus "close" and "very close").

Data analysis

Hierarchical linear regression was used to examine the association between independent variables and mental and physical scales of HRQOL. Hierarchical logistic regression to obtain prevalence odds ratios (PORs) was used to examine the association between independent variables and SRH. The intra class correlation (ICC) coefficient for the physical scale of the SF8 was 0.020 and for the mental scale was 0.012. As the ICC is less informative in binary outcome variables, the variance between the groups was determined in the null model and was 0.1755 (se $= 0.066$, $p < 0.001$) (Raudenbush & Bryk, 2002). Cross level interactions were explored and were not found. All the models assumed a random intercept form and the slopes were managed as fixed. Sampling weights were calculated due to the unequal probability of selection in both the neighborhoods and participants. The statistical analyses were conducted using Stata 10 and HLM 6.02 software (SSI, Lincolnwood, 2004).

Results

The study population was predominantly female (62.5%), with the majority of the population in the 64–70 age group (69.5%). Sixty six percent of the sample had an education level of elementary school or less. About sixty-two percent of the population reported 150 min or more of walking during the previous week. Other descriptive characteristics of the sample are presented in Tables 1 and 2.

Table 1
Descriptive characteristics of the study population ($n = 1966$).

Variables	n[a]	% – mean
Health related quality of life		
Mental dimension	1965	47.5 (SD: 10)
Physical dimension	1965	44.9 (SD: 10.2)
Self-rated health (Good, very good and excellent)	1965	41.5%
Sociodemographic indicators		
Gender		
Male	737	37.5%
Female	1229	62.5%
Age groups		
60–74 years	1366	69.5%
75–98 years	600	30.5%
Mean age years (SD)	1966	70.7 (7.7)
Education levels		
Elementary school or less	1302	66.2%
More than elementary school	664	33.8%
Time of residence		
1–15 years	672	34.2%
16–30 years	642	32.7%
31–90 years	652	33.1%
Mean years of residence (SD)	1966	24.5 (16.1)
Social Support		
Living alone		
Yes	178	9%
Living with a partner or family members	1788	91%
Walking from your house, how far do the members of your family live?		
Very far, far, neither far nor close	1228	64.8%
Close, very close	666	35.2%
Walking levels		
Minutes of walking during the last week		
$\leq$29 min	184	9.3%
30–149 min	556	28.3%
$\geq$ 150 min	1226	62.4%
Perceived environment characteristics		
Safety of parks, green areas and public recreational places[a]		
Very unsafe, unsafe, neither	1296	67%
Very safe, safe	637	33%
Missing values	33	
Safety from traffic when crossing the streets		
Very unsafe, unsafe, neither	1256	64.2%
Very safe, safe	701	35.8%
How much does street noise level of the place where you reside prevents you from walking?		
Not at all, a little, moderately	1626	82.7%
Very much, extremely	340	17.3%

[a] Sample size differs from 1966 as some variables had missing values.

Table 2
Descriptives of the objective environment characteristics in the 500 m buffer ($n = 50$).

Objective Environment Characteristics	n	% mean
Neighborhood SES		
Low	19	38%
Middle-low	26	52%
Middle-upper	5	10%
Presence of a Ciclovía corridor within a 500 m buffer		
No	37	74%
Yes	13	26%
Public park density (SD)	50	0.0661 (0.054)
Public park density tertiles of the neighborhood		
0.01–4.14% m^2 of public park area	17	34%
4.53–7.98% m^2 of public park area	17	34%
8.11–35.21% m^2 of public park area	16	32%
Number of transmilenio stations within a 500 m buffer		
Zero	33	66%
One or More	17	34%

Physical dimension of quality of life

The SF-8 mean score for the physical health dimension was 44.9 (SD: 10.2). Perception of street noise levels (β: -1.75; $p < 0.001$) was negatively associated with the physical dimension score of HRQOL. Perception of safety from traffic when crossing the streets (β: 3.02; $p < 0.001$) was positively associated with higher scores of the physical dimension of HRQOL. Similarly, walking levels of 30–149 min (β: 6.64; p: < 0.001) and 150 min or more per week (β: 9.50; p: < 0.001) had a strong and graded positive relationship with the physical dimension of HRQOL (Table 3). The Tau decreased from 2.1885 in the empty model to 0.4895 in the model with individual variables and to 0.4060 in the full model. The ICC also presented a reduction, changing from 0.0209 in the empty model to 0.0058 in the model including individual variables, and 0.0048 in the full model.

Mental dimension of quality of life

The SF-8 mean score for the mental health dimension was 47.5 (SD: 10). Perception of street noise levels (β:-1.67; p: 0.01) was negatively associated with the mental dimension of HROQL (β: -3.51; p: 0.003). Perception of parks being safe (β: 1.72; p: 0.001) and perception of safety from traffic (β: 2.09; p: 0.002) were positively associated with higher scores of the mental health dimension of HRQOL. Similarly, walking levels of 30–149 min (β: 3.41; p: 0.0001) and 150 min or more per week (β: 5.78; p: < 0.001) presented a graded positive relationship with the mental dimension of HRQOL (Table 3). The Tau for the empty model was 1.2200, and it was reduced to 0.6449 in the model including individual variables. The Tau value for the model including both individual and environmental characteristics was 0.0044. The ICC of the empty model was 0.0120, and it was reduced in the model with individual variables to 0.0071. For the final model the ICC was significantly smaller with a value of 0.0001.

Self-rated health

Overall, 41.5% of the participants perceived their health status as good, very good, or excellent. Those who reported having walked more than 150 min (POR 2.4, 95% CI: 1.6–3.5) were more likely to report good, very good, or excellent health status as compared to those who reported walking levels of less than 30 min during the week. Participants who perceived parks being safe (POR 1.40, 95% CI: 1.13–1.73), safety from traffic when crossing the streets (POR 1.54, 95% CI: 1.25–1.89), and those who resided in areas with more than 8% of the land covered by public park area (POR 1.31, 95% CI: 1.01–1.70) were more likely to report good, very good, or excellent health status (Table 4). The Tau for the empty model was 0.1755, and it was considerably reduced to 0.00015 in the model including individual variables, presenting an even more significant reduction in the full model including both environmental and individual characteristics (0.00004).

Discussion

This study found significant associations between some perceived and objective environmental characteristics and HRQOL and SRH among older adults in Bogotá. Perceived environment characteristics such as street noise, safety of public areas and street crossings were found to be significantly associated with HRQOL. Density of public parks was the only objective environment characteristic associated with SRH. This is the first study of its kind to include older adult populations, carried out in a highly urbanized city from a low-middle income country. If proven causal, the relationships found by this study suggest that particular neighborhood characteristics may identify useful intervention strategies to

Table 3
Hierarchical Linear regression analysis of HRQOL (physical and mental dimensions) by walking levels and perceived and objective neighborhood characteristics ($n = 1863$).

Variables	Physical dimension[a]				Mental dimension [a]			
	Mean	*b*	SE	*p-value*	Mean	*b*	SE	*p-value*
Walking levels								
Minutes of walking during the last week								
≤ 30 min	37.2	Ref	–	–	42.9	Ref	–	–
30–149 min	43.7	+6.64	1.06	<0.001	46.5	+3.41	0.96	0.001
≥ 150 min	46.7	+9.50	1.19	<0.001	48.8	+5.78	0.88	<0.001
Perceived environment characteristics								
Safety of parks, green areas and public recreational places								
Very unsafe, unsafe, neither	44.8	Ref	–	–	47.0	Ref	–	–
Safe, very safe	45.5	+0.59	0.45	0.195	48.7	+1.72	0.52	0.001
Safety from traffic when crossing the streets								
Very unsafe, unsafe, neither	44.0	Ref	–	–	46.9	Ref	–	–
Safe, very safe	46.9	+3.02	0.48	<0.001	48.8	+2.09	0.64	0.002
Street noise level prevents you from walking?								
Not at all, a little, moderately	45.3	Ref	–	–	47.9	Ref	–	–
Very much, extremely	43.7	−1.75	0.47	<0.001	46.3	−1.67	0.64	0.01
Objective environment characteristics								
Presence of a Ciclovía corridor within a 500 m buffer								
No	44.2	Ref	–	–	46.8	Ref	–	–
Yes	45.6	+0.24	0.53	0.654	48.2	+0.99	0.58	0.094
Public park density of the neighborhood								
0.01%–4.14% m^2 of public park area	44.2	Ref	–	–	47.4	Ref	–	–
4.53%–7.98% m^2 of public park area	45.7	+0.62	0.59	0.293	47.6	−0.02	0.65	0.975
8.11%–35.21% m^2 of public park area	44.7	+0.33	0.57	0.558	47.7	+0.06	0.72	0.933
Number of TransMilenio stations within a 500 m buffer								
Zero	44.7	Ref	–	–	47.6	Ref	–	–
One and more	45.3	−0.32	0.54	0.557	47.5	−0.08	0.62	0.893

Variance components physical dimension score. Tau: empty model (2.1885 $p = 0.001$), model with individual variables (0.4895), full model (0.4060). ICC: empty model (0.0209), model with individual variables (0.0058), full model (0.0048).

Variance components mental dimension score. Tau: empty model (1.2200 $p = 0.017$), model with individual variables (0.6449), full model (0.0044). ICC: empty model (0.0120), model with individual variables (0.0071), full model (0.0001).

+ Indicates a positive association; − Indicates a negative association.

[a] Multivariate model adjusted for gender, age, neighborhood SES, education level, time of residence in the neighborhood, living alone and proximity to family members.

Table 4
Logistic regression analysis for Self-Rated Health (Excellent, good or very good) by walking levels and perceived and objective neighborhood characteristics ($n = 1863$).

Variables	Perceived excellent, very good or good health status[a]			
	Prevalence	Adjusted POR	95% CI	*p*-value
Walking levels				
Minutes of walking during the last week				
≤ 30 min	21.2	Ref	–	
31–149 min	30.6	1.20	0.79–1.83	0.388
≥ 150 min	49.5	2.42	1.63–3.59	<0.001
Perceived environment characteristics				
Safety of parks, green areas and public recreational places				
Very unsafe, unsafe, neither	38.9	Ref	–	
Safe, very safe	47.6	1.40	1.13–1.73	0.002
Safety from traffic when crossing the streets				
Very unsafe, unsafe, neither	37.5	Ref	–	
Safe, very safe	49.2	1.54	1.25–1.89	<0.001
How much do street noise level of the place where you live prevents you from walking?				
Not at all, a little, moderately	42.6	Ref	–	
Very much, extremely	36.5	0.78	0.59–1.01	0.062
Objective environment characteristics				
Presence of a Ciclovía corridor within a 500 m buffer				
No	40.2	Ref	–	
Yes	44.9	1.04	0.82–1.33	0.743
Public park density of the neighborhood				
0.01%–4.14% m^2 of public park area	36	Ref	–	
4.53%–7.98% m^2 of public park area	44.7	1.15	0.90–1.46	0.271
8.11%–35.21% m^2 of public park area	44.8	1.31	1.01–1.71	0.046
Number of TransMilenio stations within a 500 m buffer				
Zero	68.0	Ref	–	
One and more	32.0	1.08	0.84–1.37	0.557

Variance components mental dimension score. Tau: empty model (0.1755 $p < 0.001$), model with individual variables (0.00015), full model (0.00004)

[a] Multivariate model adjusted for gender, age, neighborhood SES, education level, time of residence, living alone, and proximity to family members.

increase quality of life among the older adult population from rapidly urbanizing settings in Latin America.

Overall, scores for HRQOL in both the physical and mental dimensions were around the mean value (50, SD:10) for the general U.S. population (QualityMetrics, 2008). The results are also similar to findings from previous studies conducted in disadvantaged populations in high-income countries (Andresen et al., 2008; Bize, Johnson, & Plotnikoff, 2007; Wen et al., 2006), as well as previous evidence from the adult population of Bogotá (Cervero et al., in press; Sarmiento et al., 2007).

Consistent with our findings, previous research has shown that noise, crime and traffic density are commonly reported as barriers, affecting elderly people's well being (Balfour & Kaplan, 2002; Bazargan, 1994; Fried & Barron, 2005). According to a study conducted by the city administration of Bogotá, in 2005 there were 528 deaths of people 50 years and older due to violent causes, and 34% of those were due to traffic accidents (Secretaria de Transito, 2009). This may suggest the need to implement effective policies that reduce traffic accidents in the city, which could potentially increase perceived safety related to traffic. To address some of these safety issues, the Mayor's Office of Bogotá has formulated policy guidelines for older adults, including improving and planning physical infrastructure and street signals that are accessible and adequate for all populations. The Mayor's Office has also established future goals for the older population that include a reduction in pedestrian accidents and an increase in cultural and recreational resources ("Consejo Distrital de Política Social: Lineamientos generales de política social para Bogotá 2004–2014," 2004); however, few policies have been fully implemented and the effects of policy changes have not been evaluated.

This study found more associations between environmental perceptions and HRQOL than associations with objective measures. These findings are consistent with other studies in the field, which have found that environmental perceptions are stronger predictors of SRH (Wen et al., 2006). There is evidence that perceived and objective measures capture different constructs of well being (Gebel, Bauman, & Owen, 2009; Wen et al., 2006), and perceptions seem to be more closely related to mental and cognitive process, which directly influence quality of life and self-rated health (Balfour & Kaplan, 2002; Li et al., 2005; O'Campo & O'Brien Caughy, 2006; Wen et al., 2006). This accumulating evidence supports the hypothesis that future policies and interventions to increase quality of life could focus not only on providing and improving urban spaces but also on the social meaning and local perception of accessibility and relevance of resources among community residents. This may be even more imperative among older adults who might not be aware of changes in their local environment.

Older adults who met the current recommendations of physical activity for health of 150 min of moderate activity during the week presented higher scores of HRQOL in both the physical and mental dimensions as well as a greater likelihood of reporting very good and excellent health status. Moreover, even those who reported at least 30 min of weekly moderate physical activity also obtained greater levels of HRQOL and perceived excellent health status. This study treats physical activity as a mediator variable in the association between perceived environmental attributes and HRQOL. Consequently, all the statistical models were run controlling for physical activity and not controlling for physical activity, and the results did not present meaningful differences (Fleischer & Diez Roux, 2008). Programs and policies that facilitate and promote walking among this population should be encouraged, particularly strategies aiming to reduce traffic accidents and street noise levels, as noted earlier (Morey et al., 2008).

This study also has some limitations. It is impossible to establish any causal relationships between objective and perceived environment variables and HRQOL due to the cross-sectional study design. It is possible that people with better health prefer to live in certain types of environments, rather than certain types of environments cause good health. This concern about selection bias is mitigated by the fact that the average time of residence in the neighborhood was 24.5 years; living in a neighborhood for a long time probably reduces the likelihood of selection bias (Lash & Fink, 2003). The study design assumes that the environment as assessed at one point in time is reasonably representative of the environment exposure over time, and that people have been exposed to environmental characteristics for a long enough period of time to affect health. Of course, environments do change over time. However, these concerns are less problematic for environmental characteristics objectively measured, as they do not tend to change much as compared to the perceived environment characteristics (Gebel et al., 2009; O'Campo & O'Brien Caughy, 2006; Wen et al., 2006). In addition, older adults that are physically active may have very different environmental perceptions of the same place of residence than the ones that are inactive. It is also possible that poor psychological health might affect perceptions of the neighborhood environment, as has been shown by a previous study among adolescents (Fagg, Curtis, Clark, Congdona, & Stansfeld, 2008). The use of objective definition and measurement of the neighborhoods does not necessarily reflect resident's concept of neighborhoods. Therefore, their perceptions of the neighborhood environment might not be exactly accurate. After learning from previous studies in Bogotá, (Cervero et al., 2009; Sarmiento et al., 2007) the design of this study attempted to account for differences in the urban and social attributes of the residence areas by selecting smaller geographic areas that were highly homogeneous.

Finally, although the presence of a *Ciclovía* corridor was not found to be significantly associated with HRQOL or SRH, this study did not measure actual participation in the program, but rather used the presence of a *Ciclovía* corridor as an objective indicator. *Ciclovía* can be an indirect indicator of several factors such as presence of parks, reduction of traffic and reduction of noise and pollution levels during the days that the program is in place (Sarmiento & Behrentz, 2008). Future studies should include direct measures of older adult's participation in the *Ciclovía* due to its potential impact on physical activity and quality of life (Torres, Sarmiento, Pratt, Jacoby, Schmid, & Stierling, 2009).

The use of both objective and perceived neighborhood environment characteristics provided a broader perspective of associations between environmental factors and quality of life. The findings from this study suggest that policies that promote and ensure personal safety and safety from traffic, public parks, and noise pollution reduction could potentially influence HRQOL. The current health status of older adults can be seen as a reflection of society's investment in this age group throughout the entire course of life, including efforts related to the built environment, which may in turn influence individual perceptions and social norms within urban residents.

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